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AIR FORCE

HUMAN RESOURCES

LABORATORY

FRONT-END ANALYSIS GUIDELINES

Robert W. Stephenson

SPECIAL PROJECTS OFFICE
Brooks Air Force Base, Texas 78235-5601

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AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235-5601

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This paper has been reviewed and is approved for publication.

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Commander

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Guidelines are provided to assist Air Force Human Resources Laboratory (AFHRL) personnel in conceptualizing, planning, and conducting front-end analysis (FEA) studies. Types of analyses covered are: forecasts of future requirements, assessments of emerging technologies, research and development (R&D) plans evaluation, definition and comparison of alternative system configurations and deployment strategies, product value estimation, benefit estimation, life-cycle cost (LCC) analysis and advanced planning studies. Questions are provided to help decide which types of FEA to conduct; recommendations are made regarding the content of FEA reports; and a list of "Do's" and "Don't's" is provided for guidance of those who conduct FEAs.

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Brooks Air Force Base, Texas 78235-5601

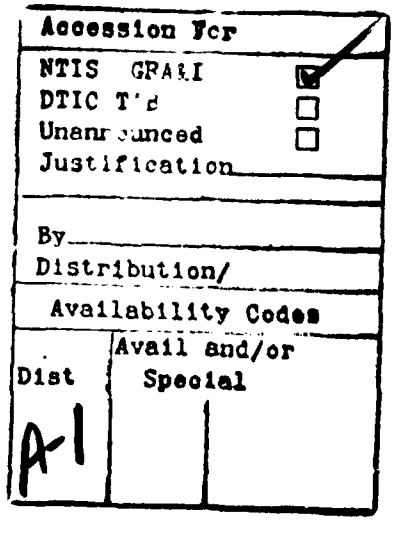
Reviewed and submitted for publication by

Herbert J. Clark
Director, Special Projects Office

Commander's Mission Statement

I'd like to introduce you to the Air Force Human Resources Laboratory (AFHRL). The basic purpose of this Laboratory is to conduct research and development in logistics, training, and personnel technologies. Our research projects include programs in personnel selection, classification and management. They cover programs in technical education and training, flying training, and team training. We conduct R&D to develop simulators for maintenance and flight training. And, finally, the Laboratory carries out research in the logistics and human factors areas of weapon system acquisition and combat maintenance.

Since the largest single item in the Department of Defense budget is the cost of personnel, and their training and administrative support, there is a greater possibility for cost savings from the human resources technology area than from all other technology areas combined.



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FRONT-END ANALYSIS GUIDELINES

I. INTRODUCTION

A. Guideline Objectives

The guidelines that follow are designed to assist Air Force Human Resources Laboratory (AFHRL) personnel in conceptualizing, planning, and conducting front-end analysis (FEA) studies. They are suggestive, rather than mandatory. There is no single model for an FEA, since each FEA undertaken should reflect the nature of the decision to be made. Those conducting an FEA are expected to use techniques and procedures that meet the objectives of the analysis being conducted, given the state of knowledge about research and development (R&D) products, baseline conditions, and systems alternatives that exist at that time.

B. Front-End Analysis

People with differing backgrounds use the term front-end analysis in different ways. Many people, for example, use the term FEA to specify the studies conducted to specify the human factors requirements of new weapon systems.

At AFHRL, the term "FEA" is used more generally to describe the analytic studies that are conducted--before as well as during the R&D process--to help plan a variety of R&D activities. It encompasses many different kinds of analysis, possibly including: forecasts of future requirements, assessments of emerging technologies, research and development (R&D) plans evaluation, definition and comparison of alternative system configurations and deployment strategies, product value estimation, benefit estimation, life-cycle cost (LCC) analysis, and advanced planning studies.

FEAs at AFHRL are designed to save resources by helping R&D managers evaluate a wide variety of important planning alternatives before the R&D investment gets too big. They are not economic analyses (EAs), although many of the methods and guidelines for EAs may apply (see section IC).

It is conceivable that an FEA could be conducted by making a half dozen telephone calls to requirement managers and experts in a particular field. The person who conducts the telephone calls may be satisfied with a quick answer to some nagging question. Other FEAs may require hundreds of thousands in contract dollars and 1 or 2 years to conduct. Regardless of the time required, if the decision is an important one, it is usually a good idea to document the analysis in writing. This permits other people to understand why you decided to do things one way rather than another, and can be very important if someone else has to take over the R&D effort for which the FEA was conducted.

C. Economic Analysis

Economic analysis (EA) is a systematic approach to the problem of choosing how to use scarce resources. It reveals the present value of the monetary costs and benefits associated with all alternatives under consideration, and provides an accurate and complete as possible a picture of nonmonetary costs and benefits. For guidance regarding how to conduct economic analysis studies see Air Force Regulation (AFR) 173-15, Economic Analysis and Program Evaluation for Resource Management.

In the Air Force, EAs are not required (paragraph 1-1-d(4), AFR 173-15) if the costs of conducting the analyses outweigh the potential benefits to decision makers. EAs are consequently not conducted for 6.2 and 6.3 R&D, since the nature of the alternatives for R&D efforts is not specific enough to justify detailed cost-analytic studies of this type.

Other uses of AFHRL funds (e.g. computer equipment, lease versus purchase decisions for large R&D support facilities) are not covered by this exemption, and EAs for such purposes are required if there is a lasting resource commitment that involves more than $1,000,000 or if the annual recurring costs are expected to exceed $100,000.

The Human Systems Division Comptroller (HSD/AC) will provide guidance and assistance regarding the need for EA studies, and will certify them upon completion. As HSD OPR (Office of Primary Responsibility) for EAs, HSD/AC is required to do these sufficiency reviews and must formally certify EAs that are to be briefed or forwarded outside of HSD.

D. FEA Policies at AFHRL

The conditions under which AFHRL personnel conduct FEAs are specified in AFHRLR 173-1, Front-End Analysis (FEA) Studies. Generally speaking, AFHRL conducts FEAs for the period covered by its 6-year research and technology plan. An FEA (AFHRLR 173-1) is required for all 6.3 efforts. FEAs may also be conducted for 6.2 efforts that involve the development of products that are transitioned directly to customers.

There is no requirement to conduct an FEA for every work unit. Many work units are a continuation of work that has been in process, and do not need an FEA. Other work units may be structured in such a way that the needed FEA is an intrinsic part of the R&D itself.

In R&D, one step leads to another. It is consequently not unusual for the first FEA to lead to another step in the FEA process. For example, an FEA concerned with future requirements may confirm that work is needed. A second FEA concerned with the assessment of emerging technologies may be needed to confirm that additional AFHRL R&D is needed; and--assuming that additional R&D really is needed--yet another FEA may be required in order to evaluate system configurations and deployment strategies before a large scale development effort is initiated.

E. Reviews of Work Unit Proposals and Plans

The Special Projects Office (AFHRL/SA) is responsible for special projects, plans, and front-end analysis studies. As part of the group's general review responsibilities for FEAs, plans analysts in SA review work unit proposals for 6.3 and 6.2 efforts from the viewpoint of whether FEAs are necessary, and make recommendations to divisions. The analysts also review work unit plans, task orders, and statements of work (SOW) to determine whether the FEAs recommended before work unit approval either have been done or are scheduled to be done.

On request, SA analysts will assist division and staff offices by reviewing plans for FEAs and consulting with personnel regarding improved methods and procedures.

F. SA-Sponsored FEAs

Assuming that the needed resources are available, FEAs by SA analysts will be authorized by the Director, Special Projects Office (SA), under one or more of the following conditions:

1. The FEA deals with new mission areas or new technological developments that are not yet part of any division's program;

2. The FEA deals with alternatives that do not fall entirely within one division's mission area;

3. A division does not have the expertise or resources to carry out a needed FEA and requests assistance; or

4. The FEA is directed by the Commander.

G. Questions Answered by FEAs.

Typical questions answered by FEAs are

Do future Air Force requirements really require R&D, or can the problem be solved in some other fashion?

In view of the work going on in industry and universities, does the Air Force really need to conduct R&D of its own?

What systems alternatives should be investigated?

What is the best plan for conducting the R&D?

Which option looks best from a life-cycle-cost point of view?

Which options provide the most benefits for the Air Force?

What type of payoff will the Air Force get for its investment in the proposed system?

Can a "crash" program be justified by the benefits that would accrue?

How can the risks inherent in the R&D be minimized?

What is the impact of minor fluctuations in external variables and conditions on the value of the systems to be developed?

II. PLANNING FEAs

A. Pre-Planning Surveys

At AFHRL, R&D in any area is preceded or accompanied by a literature search, and FEAs are no exception. When an FEA is planned, it is important that this literature search include FEAs that may have been conducted by other organizations. Special attention should be given to the possibility that relevant FEA work may already have been conducted by the Development Planning Office in HSD headquarters. HSD/XR (Deputy, Development Planning Office) publishes

two types of special area planning documents for HSD use: Requirement Identification and Technology Assessment Summaries (RIATAS), and Special Emphasis Area Plans (SEAPs). The SEAPs are updated annually.

B. Decisions About Which Type of FEA to Conduct

Exhibit II-1 is a list of questions that should be asked before FEAs are conducted. As indicated in the note at the top of the page, the more "yes" answers to the questions in each set, the more logical it is to consider a study of the type indicated in the heading for that set.

C. The Sequential Logic of FEAs

There is a definite sequential logic or priority order when decisions are made about FEAs. The first step is to fully understand future requirements (FEA type A) and the technology that is available to deal with these user requirements (FEA type B). It is also desirable to study systems change alternatives (FEA type C) before the R&D plans are prepared. Since budgets and time schedules are important considerations in decisions to conduct R&D, most analysts want to prepare a strawman set of R&D plans and evaluate R&D planning alternatives (FEA type D) before they decide to go further.

Once the base case and the alternatives have been defined, and it has been established that the R&D plans are both feasible and fundable, the analyst may want to explore the cost effectiveness of systems change alternatives. If the R&D product is tangible and it is easy to assign dollar values, the analyst may elect to conduct a product value estimation study (FEA type E). However, most R&D products at AFHRL will not be this tangible.

Product-value comparisons can be greatly simplified by setting up equal-benefit and equal-cost alternatives. These alternatives permit the analyst either to use benefit estimates to compare equal-cost alternatives (FEA type F) or to use cost estimates to compare equal-benefit alternatives (FEA type G). Both types of information are required if the costs or benefits of the options under consideration cannot be defined in such a way that they are equivalent--but it is better to avoid unequal-cost, unequal-benefit studies if possible.

Advanced planning studies (FEA type H) may also be conducted. Most studies of this type require a basic network planning diagram with scheduled milestones, product value estimates, product delivery dates, and product utilization periods. Predicted variations in the product value estimates and utilization periods are used to help evaluate such things as R&D scheduling alternatives (e.g. "crash" programs), the consequences of the risks taken at critical points (risk analysis), and the sensitivity of the R&D program to minor fluctuations in the values of key parameters and situational constraints (sensitivity analysis).

Exhibit II-1. Questions to Help Decide Which Type of FEA to Conduct

NOTE: All questions should be answered, since it is possible that more than one type of FEA is needed. Those FEAs listed early in the list (A-D) should be considered during the early R&D planning stages, regardless of whether a Program Objective Memorandum (POM) or Program Management Directive (PMD) already exists. Those listed later (E-H) are usually deferred until after the nature of the deliverables is better known. The more "yes" answers to the questions in each set, the more reason to believe that an FEA of that type should be conducted.

A. FEA to forecast future requirements[1]

1. Is the Air Force developing a new system that has not been studied before?
2. Are the user's problems poorly defined?
3. Are the conditions under which the R&D would be applied poorly understood?
4. Is there a need to explore additional systems alternatives?
5. Is it possible that some other alternative (including management decisions not requiring R&D by AFHRL) will eventually meet or change the user's requirement?
6. Is additional information needed about the long range consequences of new tactics or weapon systems design alternatives?

B. FEA to assess emerging technologies[1]

1. Is the current state of the art inadequate?
2. Are Air Force applications of new technologies uncertain?
3. Are the contributions to be expected from parallel efforts poorly understood?
4. Does more consideration need to be given to the impact of important technological developments in other fields?
5. Are important changes expected in the state of the art due to recent developments in closely related fields (g. computer technology)?

C. FEA to evaluate systems alternatives

1. Do systems alternatives need clarification?
2. Are tradeoff studies needed to help evaluate systems deployment alternatives?

[1] Relevant HSD/XR documents should be checked carefully before conducting FEAs of these two types. FEAs to forecast future requirements and assess emerging technologies are regularly conducted by HSD/XR.

3. Will the proposed cost-effectiveness estimates help to screen out or clarify systems design alternatives?

4. Are cost-benefit comparisons needed to justify resource allocation decisions?

5. Is the proposed effort large enough and important enough to justify detailed effectiveness studies of systems alternatives?

D. FEA to evaluate R&D planning alternatives

1. Are detailed R&D plans needed to help define, sell, or prepare budgets for future plans?

2. Are time and resource requirements uncertain?

3. Is an R&D budget path or "baseline" cost estimate needed to plan for, initiate, or continue work?

4. Are precise contract cost estimates needed?

5. Do the costs and benefits of important R&D planning alternatives need to be compared?

6. Is detailed information about a basic R&D plan needed to conduct advanced planning studies?

E. Product value estimation FEAs[2]

1. Is it necessary to compare the costs of product alternatives to determine if the R&D is justified?

2. Are product implementation cost estimates needed to make decisions about how the R&D should be conducted?

3. Has AFHRL agreed to conduct product value estimation studies before the products are transitioned to users and/or intermediate transitioning agents?

4. Have the users identified the kind of information that would help them to decide how the products should be implemented?

5. Can the value of the R&D products be meaningfully quantified without an excessive amount of effort?

F. Benefit estimation FEAs

[2]Most product value estimation FEAs are the responsibility of the transitioning agent (e.g. the 6.4 agency responsible for transition) rather than AFHRL. AFHRL resources should not be used for product value estimation FEAs under these circumstances.

1. Can alternatives with equal costs and differing benefits be clearly defined?

2. Can the important tangible and intangible benefits be estimated in a reasonable way?

3. Will the information about benefits be used to make important decisions about the conduct or utilization of the R&D?

G. Cost analysis FEAs

1. Can alternatives with equal benefits and differing costs be clearly defined?

2. Are future conditions understood well enough for life-cycle costs to be estimated in a realistic fashion?

3. Is information about the life-cycle costs of alternative configurations needed to make critical decisions about next steps?

4. Has AFHRL agreed to provide the transitioning agent (e.g. a 6.4 agency) with information about the life-cycle costs of alternative deployment optic...

H. Advanced Planning FEAs

1. Has a basic plan for the most logical R&D path been prepared?

2. Have product values, product delivery dates and product utilization periods been estimated?

3. Do the advantages and disadvantages of complex scheduling alternatives need to be explored?

4. Is this the right time to explore scheduling alternatives?

5. Does the R&D effort involve significant risks?

6. Is the information about risks reliable enough to justify risk analysis studies at this time?

7. Could the value of the R&D be significantly affected by fluctuations in key variables or circumstances?

8. Is this a good time to conduct sensitivity analysis studies, or should they be deferred until more information is available?

9. Has the transitioning agent (e.g. a 6.4 agency) asked AFHRL to analyze the impact of critical issues that influence product utilization?

D. Timing of FEAs

Many different FEAs are possible before, during and after an R&D project is initiated. It may be "too soon" or "too late" for one type of FEA, but just the right time to conduct an FEA of another type.

Most exploratory R&D projects at AFHRL are developing something that is not clearly established, rather than a firmly defined product. As a result, cost effectiveness studies must be timed very carefully. There is not much to be gained by making guesses about where you are going and then doing a lengthy cost-benefit analysis of the products that logically follow from those guesses. If you don't have a clear concept of what the R&D products will look like, it is "too soon" to conduct detailed cost effectiveness studies.

On the other hand, if the nature of the products is already predetermined by Tri-Service agreements or general officer commitments, there is not much to be gained by looking at alternatives that have already been excluded. It is usually "too late" to start studying alternative configurations under such circumstances.

Similar too-soon versus too-late concerns exist for forecasts of future requirements. It is "too soon" for FEAs of this type if the follow-on work cannot be initiated for several years regardless of your findings (for example, if the in-house expertise to conduct the R&D were not available). However, it is "too late" if the future requirements to be studied have already been established by circumstances beyond the Laboratory's control (e.g. a Major Command or Tri-Service agreement or a Congressional mandate).

III. CONTENTS OF EAs AND FEAs

A. Guidance contained in AFR 173-15

AFR 173-15 contains useful information about the suggested contents of EAs, and should be examined very closely if cost effectiveness comparisons are planned as part of your FEA. Exhibit III-1 (abstracted from AFR 173-15) contains information about the contents of EA reports. Note that the content areas listed are required rather than optional. Since AFR 173-15 could conceivably be revised after the present guidelines are published, those who conduct EAs are encouraged to check a current copy of this regulation for guidance.

B. General Guidance Regarding the Contents of FEAs

There is no single model for an FEA, and each FEA should reflect the nature of the decision to be made. General recommendations for the contents of FEA reports are provided in Exhibit III-2. Significant tailoring of these optional section headings is required for each of the eight types of FEAs listed in Exhibit II-1.

Exhibit III-1. Required Contents of EA Reports
(from p. 6 of AFR 173-15)

2–1. General Information. Economic analysis (or cost-benefit analysis) is a method for systematically comparing competing project alternatives. Cost is not the sole criterion on which project selection should be based; economic analysis offers a means of systemically assessing both monetary and nonmonetary costs and benefits across alternatives. An economic analysis is only as good as the process by which it is undertaken. Identification and valuation of costs and benefits structure the whole analysis; therefore, it is essential that these processes be conducted according to sound methodology and good common sense. The guidelines below are designed with this in mind. Each economic analysis must include at least the following:

a. An executive summary with recommendations. The summary should be self-contained but concise; the reader should be able to grasp the basic facts quickly and understand the recommendation.

b. A clear statement of the problem or objective (i.e., mission or mission support requirement) to be met by the alternatives under study.

c. Relevant assumptions, criteria, and variables which influence cost and effectiveness, such as required operational readiness dates, assumptions about future energy prices, etc.

d. A complete list of alternatives considered to meet the objective. If alternatives to current programs are covered in the analysis, then the status quo must be explicitly included as a separate alternative.

e. A thorough description of each feasible alternative that could fulfill the program or project objective. The description of alternatives should include a concise explanation of how each process or procedure would work; what personnel, equipment, or facilities would be required; and what other changes would be involved. Any alternative judged infeasible must be identified and the grounds for its rejection documented.

f. Estimation of costs and benefits of each alternative. The costs and benefits of the alternatives should be summarized; cost and benefit tables, sources, and computations should be included as attachments. All resources required to achieve stated objectives are to be shown. With a few exceptions (analyses of lease versus buy and other purely financial decisions), all calculations should be in constant (real or deflated) dollars. To compare programs or projects more accurately, costs and benefits for each alternative should be divided according to whether they are monetary in nature or not. Paragraph 2–4 provides further guidelines for estimating costs and benefits.

(1) Monetary costs or benefits are those which take the form of specific financial outlays or receipts. The list of costs for each alternative should be exhaustive, but care must be exercised to ensure against double counting. Specific treatment of various cost elements is further detailed in paragraph 2–4. Monetary benefits (such as the proceeds from the sale of assets, lease fees, etc.) should be thoroughly documented. A final calculation of discounted net costs (i.e., monetary costs *minus* monetary benefits) should be presented for each alternative.

(2) Nonmonetary costs and benefits are those which cannot be stated in dollar terms. A nonmonetary cost is a reduction of capability or performance brought about by the selection of a particular alternative; similarly, a nonmonetary benefit is an enhancement of capability or performance. Those nonmonetary costs and benefits which lend themselves to direct quantitative measurement should be compared on that basis. Degradations to or enhancements of other programs should be included as nonmonetary costs or benefits.

(a) Cost and benefit calculations should be based on the most accurate data available; case specific data (i.e., data pertaining to the project or circumstances at hand) should be used to the greatest extent possible. Otherwise, average values from a variety of sources can be used.

(b) When future costs or benefits are uncertain (e.g., because of the nature of the forecasting process), sensitivity analysis should be used to evaluate the risk attending the estimate used.

g. A summarization of each alternative. A comparison should be made showing the relative strengths and weaknesses of each alternative and identifying the most effective alternative for accomplishing the mission objective. This comparison should include all life-cycle dollar costs and benefits and nonmonetary costs and benefits not common to all of the alternatives.

Exhibit III-2. Suggested Contents Of FEA Reports

Summary	An executive summary of the information contained in the report, including recommendations and the analyst's overall evaluation.
User Requirement	A description of the problem or objective as it is seen by the user.
Base Case	A description of the operational systems as they exist now, as well as the changes that are expected to occur independently of the proposed R&D as a natural result of external events and management decisions.
Relevant Technology	A description of the current state of the art in the technology that would be used to meet user requirements
Systems Change Alternatives	A description of systems change alternatives, including low cost alternatives to the R&D products that would be developed by the proposed R&D as well as the alternative of letting the system evolve without R&D by AFHRL.
Plans for R&D	This should include: the objectives of the proposed R&D, the products to be developed, the technical methods used to develop the R&D products, and a description of parallel R&D efforts with which the proposed R&D must be coordinated.
Scope of FEA	This should include the specific objectives of the FEA, the assumptions used to estimate costs and benefits, and a description of how the FEA data were obtained.
Options Considered	The who, what, where, when, and why of the options that were considered as part of the analysis.
Costs	R&D costs, deployment and O&S costs, cost avoidance expectations, total life-cycle costs of alternative configurations.
Benefits	The term "benefits" does not include cost avoidance values (e.g. training cost avoidance, accident cost avoidance), which are treated separately as cost adjustment factors. Examples of benefits are: increased sortie rate, greater availability of in-flight hours to practice critical tasks, more sustainable operations at dispersed bases, and enhanced combat performance.
Effectiveness Comparisons	Cost effectiveness comparisons of significant options, usually including the baseline condition and one or more systems change alternatives. Narrative descriptions of benefits and rank orderings of alternatives are permitted when quantification is not feasible or practical.
Conclusions	This section describes the implications of the analysis for the proposed R&D and the basis for the analyst's conclusions about it.

C. Sources of Information about Costs

AFR 173-13, US Air Force Cost and Planning Factors, provides cost information and ground rules that can be used to estimate resource requirements and costs associated with Air Force structures, missions, and activities. Chapter headings in the 197-page document are: General Information, Logistics Factors, Personnel Factors, Programming Factors, Inflation Factors, Attrition Factors, and Cost Models.

Another useful source of information is the Air Force Almanac, which is published in the May issue of *Air Force Magazine*. The information contained in this unofficial source (which includes estimated purchases of new weapon systems) has an advantage in that the analyst need not be concerned about the possibility that the information used in the analysis might be classified or procurement-sensitive in some way.

Current information about the Office of the Secretary of Defense inflation rates and a variety of cost models can be obtained from the Air Force Cost Center. The Air Training Command (ATC) Cost Handbook, which is maintained by ATC headquarters and revised annually, is a useful source of information about training costs.

D. Specific Content Recommendations

Specific content recommendations for each of the eight types of reports are contained in exhibit III-3.

Exhibit III-3. Suggested Contents of FEA Reports

FEAs develop and present information that helps us make better decisions about new products AFHRL should develop for the Air Force and ways in which the Laboratory should develop them. Suggested contents of FEA reports are:

a. Forecasts of Future Requirements. These forecasts provide systematic information about the future environments in which the Air Force will have to carry out its missions. They also identify the capabilities required to carry out the missions successfully. Forecasts of future requirements should include descriptions of the baseline situation, forecasted changes in enemy capabilities, combat implications, Air Force problems, available solutions to the problems, and solutions requiring R&D.

b. Assessments of Emerging Technologies. These assessments provide information about the potentials of emerging technologies for enhancing mission effectiveness and their possible consequences for future requirements. They should include descriptions of the current state of the art, of ongoing and planned R&D, and of specific Air Force problems that could be alleviated or solved by the new technology.

c. Definitions and Evaluations of Alternative System Configurations and Deployment Strategies. Results provide information about the likely costs and effectiveness of conceptually different systems that could be developed. They provide information for deciding what new systems to develop. These FEAs should include projections of the baseline situation, systems definitions, alternative systems configurations and deployment strategies, estimates of life-cycle costs, estimates of the effectiveness associated with each system alternative or deployment strategy, and an assessment of the likely efficiency of each system concept in carrying out the Air Force mission.

d. R&D Plans Evaluations. Plans evaluations provide information useful in deciding how to achieve an R&D goal. They should include descriptions of the R&D objectives, time and cost constraints, important milestones and coordination requirements, joint effort possibilities, network planning diagrams for alternative R&D strategies, and estimates of the cost and time required to carry out each R&D strategy.

e. Product Value Estimation Studies. These studies provide information useful for deciding whether to develop a product. They provide information about the likely costs and benefits of R&D products, if the products were to be implemented. Product value estimation studies should include descriptions of the R&D products, alternative subsystem configurations and utilization plans, assertions underlying cost and benefit estimates, life-cycle cost estimates, benefit estimates, and cost-benefit comparisons for alternative subsystems and utilization plans

f. Benefit Estimation Studies. Such studies provide information about the nature and likely magnitude of the benefits that would stem from the operational use of a new product. They should include functional descriptions of how a new product would benefit the Air Force, descriptions of benefit-estimation and data-collection methodologies, documentation of the relationships between system characteristics, deployment strategies and benefit levels, and comparisons of benefit levels. Benefit estimation studies can support product value estimation and planning studies.

g. Life-Cycle Cost Analyses. These analyses provide information regarding how much it would cost the Air Force to develop, implement, and use an R&D product or system. They should include descriptions of the alternatives to be evaluated, enumeration of all cost elements, documentation of all cost estimating parameters/relationships/models, and the life-cycle costs estimated. Air Force policy regarding the computation of life-cycle costs (AFR 800-11) should be followed. Life-cycle cost analyses can support evaluations of alternative system configurations and deployment strategies, product value estimation studies, and planning studies.

h. Planning Studies. These are studies that require the use of network diagram and value estimation techniques which help answer questions about the ways in which existing R&D plans might be changed. Examples of planning studies are: Schedule analysis, risk analysis, and sensitivity analysis. For schedule analysis studies, network diagrams are prepared in which separate time, resource requirement, and benefit estimates are obtained for two or more scheduling options. The impact of the alternative schedules on benefit periods, costs, and benefits is then determined. Schedule analysis studies are done when the length of the benefit period is a critical factor or when a "crash" schedule has been proposed. Risk analysis studies evaluate the risks involved in conducting an R&D effort, with emphasis on the cost/benefit consequences of alternative events and research and development outcomes. Risk analysis studies are appropriate when reasonable estimates can be made of the probabilities that the alternative events that are expected to affect R&D outcomes will occur. Sensitivity analysis studies examine the effect obtained by repetitive changes in the direction and/or magnitude of the cost/benefit values embedded in the analysis. Sensitivity analysis studies are appropriate when events are uncertain and information is needed about the impact that alternative cost and benefit values might have on the overall value of an effort.

IV. DOCUMENTING FEAs

A. R&D Case File Documentation

FEA information, like all important forms of information about the conduct of an R&D effort, is maintained in the R&D case file. AFR 12-50 (Vol. II), Table 80-2, contains guidance regarding the content of R&D case files.

B. Documentation Maintained by AFHRL/SA

As required by AFHRLR 173-1, the Special Projects Office (AFHRL/SA) makes recommendations regarding FEAs following the annual "program call" in which work unit validation decisions by Division Chiefs are reviewed by the AFHRL Commander and his staff. SA analysts also track FEAs for 6.3 projects during staff assistance visits.

Information about the need for FEAs is documented in the Commander's "program call" evaluation letters. Information about division progress in conducting FEAs is documented in SA staff assistance visit reports.

V. GENERAL RECOMMENDATIONS FOR FEAs

The following "Do's" and "Don't's" are offered for your consideration when FEAs are being planned, conducted, and reported.

	DO...	DON'T...
OBJECTIVES	Conduct a rational and independent study of the advantages and disadvantages of the alternatives under consideration.	Permit the design of a study to be influenced by pressures that may exist for or against a proposal.
	Study alternatives that have a high probability of occurring.	Study alternatives that have a low probability of occurring.
	Give priority in study selection decisions to those items that have the most important resource implications and the greatest payoff potential.	Give priority to studies that won't have much impact when they are finished.
STUDY FOCUS	DO...	DON'T...
	Give first priority to your own understanding of the problem.	Assume that your initial views of what is needed are correct.
	Give second priority to base case definition if the base case is unclear.	Start work without fully understanding the baseline conditions.
	Give third priority to your thoughts about systems change alternatives.	Accept existing systems alternatives without question.

	Focus upon costs and benefits that make a difference.	Try to include all costs and benefits that could be considered as part of every analysis.
	Screen out alternatives that are not competitive when analytic comparisons are made.	Try to analyze all of the alternatives that could be analyzed.
STUDY DESIGN	DO...	DON'T...
	Design each analysis as a completed study.	Defer conclusions until additional analyses have been conducted.
	Design FEAs to facilitate important research decisions and resource allocation decisions.	Design FEAs to focus upon the less important decisions.
	Focus on future conditions that will be impacted by the R&D products to be developed.	Spend too much time on existing conditions.
SCOPE OF ANALYSIS	DO...	DON'T...
	Consider the possibility that the requirement or the work schedule could be modified in ways that would improve the value of the R&D to the Air Force.	Assume that existing requirements and work schedules should not be changed in any way.
	Focus the analysis upon those costs and benefits that are most relevant for the options under consideration.	Try to include all of the costs and benefits that could possibly be considered.
METHODS	DO...	DON'T...
	List the potential benefits and describe the scientific and technical bases upon which the benefits are projected.	List benefits without explaining their rationale.
	Use ratings and rankings when hard data are not available.	Try to justify with quantitative data every point that is made.
	Ask personnel outside of your organization for information that is either readily available or can be quickly estimated.	Ask personnel outside of your organization for information that would be difficult and time consuming to provide.
	Try to develop specific estimates of costs and benefits.	Accept very general statements like "improve readiness."

	Use shortcut quantification methods when necessary, such as assumption-based estimates, percentage estimates of possible values, and illustrative values.	Insist upon hard data when the situation and/or the time constraints don't permit it.
	Use order of magnitude (one or two significant digits) value estimates when necessary.	Give the appearance of having numbers with multi-digit accuracy when that degree of accuracy does not really exist.
	Make preliminary assessments of the sensitivity of results to possible changes in values.	Conduct complex sensitivity analysis studies that are not really necessary.
	Analyze risks that have a good chance of impacting the success of the proposed R&D.	Try to analyze every risk involved in an R&D effort.
	Consider the impact of important scheduling options on benefit periods.	Let the accidents of budget determine the duration of the benefit periods.
	Try to modify readily available data for your use.	Develop sophisticated projection methods that are not really needed.
REPORTS	DO...	DON'T...
	Identify unresolved questions in your report.	Violate the constraint that each report must stand on its own merits as a completed study.
	Briefly indicate any uncertainties in the data and the sensitivity of the results to the analytic approach that was used.	Give the impression that the data are better than they really are.

REFERENCES

AFHRL Regulation 173-1. (1990, July) *Front-end analysis (FEA) studies*. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory.

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